Glass and Ceramics, Vol. 67, Nos. 11 – 12, March, 2011 (Russian Original, Nos. 11 – 12, November – December, 2010)

UDC 666.5

PARTICULARS OF A CASTING SPOT DEFECT

T. L. Neklyudova[1] and N. S. Rusovich-Yugai[1]

Translated from *Steklo i Keramika*, No. 12, pp. 20 – 21, December, 2010.

The structure of a casting spot defect on porcelain articles is investigated. Recommendations are made for eliminating this defect. These recommendations can also be used in the manufacture of articles by casting using faience, majolica, and other materials.

Key words: porcelain, slip casting, casting spot defect.

Porcelain manufacturers use one of the common formation methods to manufacture articles with a complicated shape — casting. The formation of the thickness of the wall of a ceramic article depends on many factors, including on the rheological properties and filtration rates of the slip, the moisture content, the porosity of gypsum molds, the curing time of the slip in gypsum molds, and other factors.

Manual casting of ceramic articles is considered to be laborious because of the complexity of the process. The quality of a cast intermediate product largely depends on the skill of the caster. A common type of reject from the technological process of casting is a defect called a casting spot, having a rounded shape, in the form of a prolate drop or bands. This type of reject can be observed in many articles formed by casting, irrespective of the type of ceramic materials (porcelain, faience, majolica). This defect appears on the form of a slight depression of the surface of an article and a change of color (darkening).

The shape of a casting spot defect depends on the directionality of the slip stream into the gypsum mold. For example, rounded spots are formed at the location where an almost perpendicularly incident slip stream touches the bottom of the mold; prolate drops and bands form when the slip stream is incident along the wall of the gypsum mold (Fig. 1). In addition, it was found that the dryness of the gypsum molds and low moisture content of the slip used, as a rule, lead to intense formation of the casting spot defect [1].

Different recommendations have been made to eliminate the casting spot rejects: feed slip through a perforated pouring setup and using gypsum molds with normal porosity and moisture content.

To study the casting spot phenomenon samples of household porcelain in the air-dried and fired states with a casting spot at different locations and with no spot were obtained from the clamp and studied in an immersion liquid. A sharp difference was found in the content and particle size of quartz at the locations examined. For example, quartz in the region of the defect was characterized by smaller sizes and low content, which microscope studies performed in polarized light confirm. As a result it was determined that quartz particles in the region of a defect are 10 – 30 μm in size in contrast to quartz particles reaching 100 – 150 μm on sections of porcelain with no defectiveness (Fig. 2).

The casting spot defect structure was studied using microscopic analysis on sections and polished sections fabricated from transverse cuts of the defect. A characteristic feature is the density of the structure in the locations of the defect, caused by the low particle-size dispersion of the particles in this region. A 300 – 350 μm wide zone of a defect is clearly determined in Fig. 3; here rare oriented grains of quartz are encountered, in contrast to the structure of the main porcelain as well as a deficient content of pores and

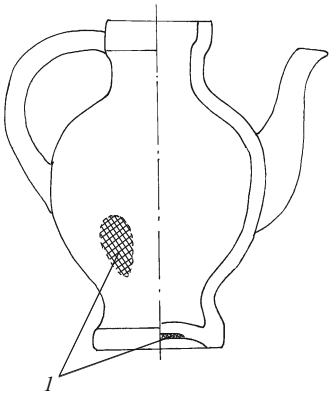

Fig. 1. Schematic diagram of a casting spot defect: *1*) regions of defects.

[1] Gzhel' State Commercial Art Institute, Gzhel', Moscow Oblast, Russia (e-mail: nama7@yandex.ru).

TABLE 1. Structural Characteristics of Porcelain Fired at Low Temperature with and without a Casting Spot Defect

Zones of investigation of the article surface	Porcelain structure					
	quartz grain undissolved during firing			pores		
	content, %	average size, μm	maximum size, μm	content, %	average size, μm	maximum size, μm
Without casting spot defect	13.7	14.6	100 – 120	8.1	11.8	70 – 80
With casting spot defect	3.9	9.3	20 – 25 (individual to 80)	5.0	8.3	20

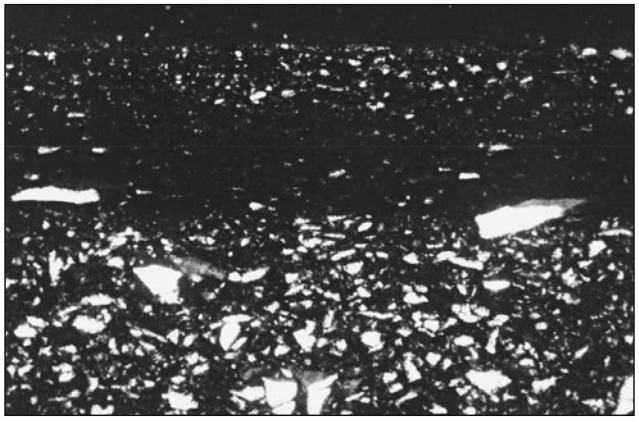

Fig. 2. Structure of porcelain with a casting spot defect, polarized light, × 141.

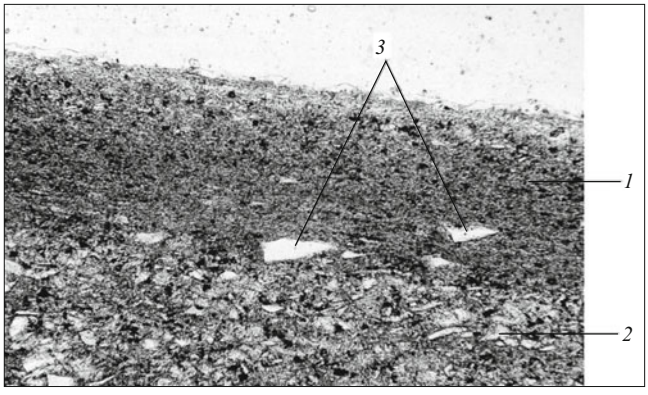

Fig. 3. Structure of porcelain with a casting spot defect: *1*) defect region; *2*) porcelain region; *3*) single, oriented undissolved quartz particles, × 141.

their negligible size (see Table 1). In contrast, quartz grains of different sizes as well as clusters of mullite needles at the location of feldspar grains are present in the structure of high-quality porcelain.

In ready articles, some depression of the surface layer of glaze caused by the characteristic structural nature of a defect can be observed at the casting spot locations. Since the width of the defective zone is in the range of 400 μm, i.e., the penetration depth of the defect into the body of the porcelain as well as the area of the defect, it can be recommended that a casting spot defect be removed mechanically from the surface of the dried intermediate product at the mounting stage.

In summary, it can be supposed that when the slip first touches the gypsum surface it undergoes separation, at this moment a section which is distinguished from all other sections by elevated density, low porosity, and color forms from the finely dispersed clay particles of the slip. Such sections with a casting slip defect lower the quality of the ready articles.

These recommendations for eliminating this defect increase the quality of the ready articles, but they do not eliminate this form of defectiveness completely.

REFERENCES

1. A. P. Pyzhova, V. V. Korobkina, and V. S. Kosov, *Defects of Fine Ceramic Articles* [in Russian], Legprombytizdat, Moscow (1993).